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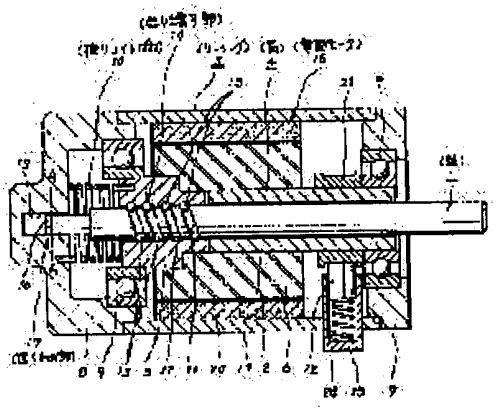
(54) ELECTRIC LINEAR ACTUATOR

(57)Abstract:
PURPOSE: To suppress electric consumption and hysteresis.
CONSTITUTION: A shaft 1 is supported in a casing 5 permitting displacement only along the shaft direction. A cylinder 4 provided at the periphery of the shaft 1 is supported in the casing 5 permitting only revolution. Elastic force in the revolving direction is applied to the cylinder 4 by a torsion coil spring 10. An electric motor 18 is provided between the casing 5 and the cylinder 4. The electric motor 18 revolves the cylinder 4 in the reverse direction to the elastic force of the torsion coil spring 10 when current is conducted. A feed screw 14 is provided between the cylinder 4 and the axis 1 and a baffle 17 which prevents the revolution of the axis 1 is provided between the casing 5 and the axis 1. Therefore, the axis 1 displaces in the axis direction when the cylinder 4 is revolved.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] Since the flow control valve prepared for example, in the middle of various hydraulic circuits is driven, the electromotive linear actuator concerning this invention is used.
[0002]
[Description of the Prior Art] For example, in order to drive the flow control valve prepared in the hydraulic circuit prepared in an automobile based on the instructions from a controller, the linear actuator of an electric formula is needed. For this reason, the electromotive linear actuator which combined a solenoid and compression spring is used from the former.
[0003] the electromotive linear actuator known from this former -- the variation rate of a rod etc. -- a member -- the aforementioned compression spring -- one side -- energizing -- this variation rate -- energizing to the aforementioned solenoid, when the variation rate of the member needs to be carried out -- the above -- a variation rate -- the variation rate of the member is resisted and carried out to the elasticity of the aforementioned compression spring a variation rate -- the variation rate of a member -- an amount -- the amount of energization to the aforementioned solenoid -- controlling -- this solenoid -- the above -- a variation rate -- it adjusts by changing the size of the force of attracting a member That is, to the position where the elasticity of the aforementioned compression spring and the suction force of the aforementioned solenoid balance, the aforementioned displacement member is displaced and stops.
[0004]
[Problem(s) to be Solved by the Invention] However, since it is necessary to pass big current to a solenoid in case the variation rate of the displacement member is carried out in the case of the conventional electromotive linear actuator using the above solenoids, for example, when it is used for a switch of the hydraulic circuit of an automobile, it becomes the cause which applies a burden to a dc-battery, and is not desirable.
[0005] moreover, the thing for which the elasticity of compression spring and the suction force of a solenoid are balanced -- the above -- a variation rate -- the variation rate of a member -- although an amount is adjusted -- compression spring -- a variation rate -- since the structure which energizes a member has a large hysteresis, ****** it passes the same current as the aforementioned solenoid -- the above -- a variation rate -- the case where another side is made to carry out the variation rate of the member to the case where a variation rate is carried out to one side -- a variation rate -- For this reason, it was difficult to fine-adjust the opening of a flow control valve etc.
[0006] The electromotive linear actuator of this invention cancels above un-arranging.
[0007]
[Means for Solving the Problem] The electromotive linear actuator of this invention the relative rotation to this shaft among the cylinder prepared as free, and this cylinder and the aforementioned

shaft to a shaft, this shaft, and this heart The elastic member to which it is prepared between a member and the portion of fixation, and while only rotation is free gives the elasticity of a hand of cut to the member of one of these, The delivery thread part to which it is prepared between the periphery side of the aforementioned shaft, and the inner skin of the aforementioned cylinder, and the variation rate of the member of another side of the aforementioned shaft and the cylinders is carried out [shaft orientations] with rotation of aforementioned one member, Casing prepared in the circumference of the aforementioned cylinder, and the electrical motor which it is prepared inside this casing, and the elasticity of the aforementioned elastic member is resisted [electrical motor] and makes it rotate aforementioned one member with energization, It is prepared between the aforementioned casing and the member of aforementioned another side, and although the variation rate covering the shaft orientations of the member of this another side is permitted, it consists of the baffle sections which prevent rotation.

[0008]

[Function] In the case of the electromotive linear actuator of this invention constituted as mentioned above, on the other hand at the time of un-energizing to an electrical motor, one member of a shaft and the cylinders rotates to ** by the elasticity of an elastic member. Under the present circumstances, in order for the member of another side of the aforementioned shaft and the cylinders to have rotation prevented by the baffle section, the member of this another side is made to carry out the variation rate of it even to a shaft-orientations end by the delivery thread part.

[0009] Moreover, if it energizes to an electrical motor, aforementioned one member will rotate according to the amount of energization. That is, the member of one of these stops in the state where it rotated even in the state where the rotation torque of the aforementioned electrical motor which becomes settled according to the amount of energization, and the elasticity of the aforementioned elastic member balance. And the member of aforementioned another side displaces towards the shaft-orientations other end with rotation of aforementioned one member by the aforementioned delivery thread part.

[0010]

[Example] Drawing 1 -2 show the example of this invention. The shaft 1 prepared in the core is displaced only to shaft orientations (longitudinal direction of drawing 1), without rotating, and the valve element of a flow control valve etc. is driven (a parallel displacement is carried out). The cylinder 4 which combined the first cylinder part 2 and the second cylinder part 3 of each other with the circumference of this shaft 1 in series is formed in this shaft 1 and this heart, and casing 5 is further formed in the circumference of this cylinder 4.

[0011] Connecting through the armature 6 mentioned later, in the first cylinder part 2, the second cylinder part 3 is supporting only rotation free through anti-friction bearings 9 and 9 on the inner circumference edge of the front lid 7 of the aforementioned casing 5 at the opening marginal part of the back lid 8, respectively among the first cylinder part 2 of the above and the second cylinder part 3 which constitute the aforementioned cylinder 4.

[0012] Moreover, the end of the twisted coil spring 10 which is an elastic member is stopped to the end face of the second cylinder part 3 of the above, and the other end of this twisted coil spring 10 is stopped to the inside of the lid 8 after the above, respectively. Consequently, it will be in the state where the elasticity of a hand of cut was given to the cylinder 4 containing the second cylinder part 3 of the above.

[0013] Moreover, a ball screw mechanism is constituted and the delivery thread part 14 to which the variation rate of the aforementioned shaft 1 is carried out [shaft orientations] consists of forming two or more balls 13 and 13 between the spiral slot 11 formed in the periphery side of the aforementioned shaft 1, and the spiral slot 12 formed in the inner skin of the second cylinder part 3 which constitutes the aforementioned cylinder 4 with rotation of the second cylinder part 3 of the above. On the other hand, the non-pillar section 16 which formed the crevice 15 of a non-round shape as shown in

drawing 2 , and was formed in this crevice 15 at the edge of the aforementioned shaft 1 is inserted in the inside center section of the lid 8 after the above. And by engagement to this non-pillar section 16 and the aforementioned crevice 15, although the variation rate covering the shaft orientations of the aforementioned shaft 1 is permitted, the baffle section 17 which prevents rotation of this shaft 1 is constituted.

[0014] Furthermore, inside the aforementioned casing 5, the electrical motor 18 which the elasticity of the aforementioned twisted coil spring 10 is resisted [electrical motor], and makes it rotate the aforementioned cylinder 4 with energization is formed. That is, a permanent magnet 20 is fixed to the inner skin of the body 19 which constitutes the drum section of the aforementioned casing 5, and the periphery side of an armature 6 which built inner skin, and the first cylinder part 2 of the above and the second cylinder part 3 of this permanent magnet 20, and was established is made to counter. The commutator 21 is fixed to the periphery side of the first cylinder part 2 of the above, and the inner end face of a brush 22 is made to **** to the periphery side of this commutator 21. This brush 22 is fitted in in the electrode holder 23 fixed to the aforementioned body 19 considering the variation rate covering the diameter direction of this body 19 as free, and is pressed towards the aforementioned commutator 21 by compression spring 24.

[0015] In the case of the electromotive linear actuator of this invention constituted as mentioned above, on the other hand at the time of un-energizing to an electrical motor 18, a cylinder 4 rotates to ** by the elasticity of a twisted coil spring 10. Under the present circumstances, the aforementioned shaft 1 does not rotate with the aforementioned cylinder 4 by engagement to the inner skin of a crevice 15 and the periphery side of the non-pillar section 16 which constitute the baffle section 17. The aforementioned shaft 1 is made to carry out a variation rate even to a shaft-orientations end for this reason by the aforementioned delivery thread part 14.

[0016] Moreover, if it energizes to an electrical motor 18 through the aforementioned brush 22, the aforementioned cylinder 4 will rotate according to the amount of energization. That is, this cylinder 4 stops in the state as it is, unless it rotates even in the state where the rotation torque of the aforementioned electrical motor 18 which becomes settled according to the amount of energization, and the elasticity of the aforementioned twisted coil spring 10 balance and the amount of energization is changed.

[0017] Since the delivery thread part 14 which is a ball screw mechanism is formed between the inner skin of the second cylinder part 3 and the periphery sides of the aforementioned shaft 1 which constitute the aforementioned cylinder 4, the aforementioned shaft 1 displaces towards the shaft-orientations other end with rotation of the aforementioned cylinder 4 by the aforementioned delivery thread part 14. Therefore, if the valve element of a flow control valve etc. is supported at the edge of the aforementioned shaft 1, control of flow by this flow control valve can be performed by changing the amount of energization to the aforementioned electrical motor 18.

[0018] A twisted coil spring 10 has the small hysteresis of the spring itself compared with the hauling spring built into the linear actuator of the aforementioned conventional solenoid formula, and since the structure for moreover changing the turning effort of an electrical motor 18 into the variation rate of a shaft 1 is also constituted by the ball screw mechanism in which friction loss is small, the hysteresis as the whole linear actuator becomes a small thing. Moreover, since the delivery thread part 14 by the aforementioned ball screw mechanism increases the torque of an electrical motor 18 and it transmits to the aforementioned shaft 1, in order to carry out the variation rate of this shaft 1 [shaft orientations], the value of the current energized to the aforementioned electrical motor 18 is comparatively small, and ends.

[0019] In addition, when it constitutes the electromotive linear actuator of this invention, contrary to the case of illustration, a shaft 1 can be rotated and it can also consider as the structure of carrying out the variation rate of the cylinder 4 to shaft orientations.

[0020]

[Effect of the Invention] In order that the electromotive linear actuator of this invention may be constituted as it was stated above, and it may act, it can acquire the big force by few power consumption, and, moreover, becomes possible [controlling various devices, such as a flow control valve, delicately] as a small electromotive linear actuator of a hysteresis.

[Translation done.]

* NOTICES *

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2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] For example, in order to drive the flow control valve prepared in the hydraulic circuit prepared in an automobile based on the instructions from a controller, the linear actuator of an electric formula is needed. For this reason, the electromotive linear actuator which combined a solenoid and compression spring is used from the former.
[0003] the electromotive linear actuator known from this former -- the variation rate of a rod etc. -- a member -- the aforementioned compression spring -- one side -- energizing -- this variation rate -- energizing to the aforementioned solenoid, when the variation rate of the member needs to be carried out -- the above -- a variation rate -- the variation rate of the member is resisted and carried out to the elasticity of the aforementioned compression spring a variation rate -- the variation rate of a member -- an amount -- the amount of energization to the aforementioned solenoid -- controlling -- this solenoid -- the above -- a variation rate -- it adjusts by changing the size of the force of attracting a member That is, to the position where the elasticity of the aforementioned compression spring and the suction force of the aforementioned solenoid balance, the aforementioned displacement member is displaced and stops.

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EFFECT OF THE INVENTION

[Effect of the Invention] In order that the electromotive linear actuator of this invention may be constituted as it was stated above, and it may act, it can acquire the big force by few power consumption, and, moreover, becomes possible [controlling various devices, such as a flow control valve, delicately] as a small electromotive linear actuator of a hysteresis.

[Translation done.]

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TITLE: ELECTRIC LINEAR ACTUATOR

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ABSTRACT:

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which prevents the revolution of the axis 1 is provided between the casing 5
and the axis 1. Therefore, the axis 1 displaces in the axis direction when the
cylinder 4 is revolved.

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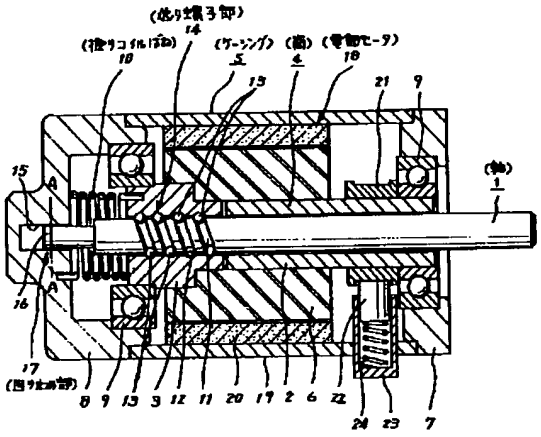
(54)【発明の名称】　電動式リニアアクチユエータ

(57)【要約】
【目的】電力消費並びにヒステリシスを小さく抑える。
【構成】軸１をケーシング５の内側に、軸方向に亙る変位のみ自在に支持する。軸１の周囲に設けた筒４を前記ケーシング５の内側に、回転のみ自在に支持する。捩りコイルばね１０により前記筒４に、回転方向の弾力を付与する。ケーシング５と筒４との間に電動モータ１８を設ける。この電動モータ１８は、通電に伴なって前記筒４を、捩りコイルばね１０の弾力方向と逆方向に回転させる。筒４と軸１との間には送り螺子部１４を、ケーシング５と軸１との間にはこの軸１の回転を阻止する周り止め部１７を、それぞれ設ける。従って、前記筒４の回転に伴なって前記軸１が、軸方向に変位する。



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【特許請求の範囲】

【請求項1】　軸と、この軸と同心に、この軸に対する相対的回転を自在として設けられた筒と、この筒と前記軸との内で、回転のみ自在な一方の部材と固定の部分との間に設けられ、この一方の部材に回転方向の弾力を付与する弾性部材と、前記軸の外周面と前記筒の内周面との間に設けられ、前記一方の部材の回転に伴なって、前記軸と筒との内の他方の部材を、軸方向に亙って変位させる送り螺子部と、前記筒の周囲に設けられたケーシングと、このケーシングの内側に設けられて、通電に伴なって前記一方の部材を、前記弾性部材の弾力に抗して回転させる電動モータと、前記ケーシングと前記他方の部材との間に設けられ、この他方の部材の軸方向に亙る変位は許容するが回転を阻止する回り止め部とから成る電動式リニアアクチュエータ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明に係る電動式リニアアクチュエータは、例えば各種油圧回路の途中に設ける流量制御弁等を駆動する為に利用する。

【0002】

【従来の技術】例えば自動車に設けられる油圧回路に設ける流量制御弁等を、制御器からの指令に基づいて駆動する為には、電動式のリニアアクチュエータが必要となる。この為従来から、ソレノイドと圧縮ばねとを組み合わせた電動式リニアアクチュエータが使用されている。

【0003】この従来から知られた電動式リニアアクチュエータは、ロッド等の変位部材を前記圧縮ばねによって一方に付勢しておき、この変位部材を変位させる必要が生じた場合には、前記ソレノイドに通電する事により前記変位部材を、前記圧縮ばねの弾力に抗して変位させるものである。変位部材の変位量は、前記ソレノイドへの通電量を制御し、このソレノイドが前記変位部材を吸引する力の大きさを変える事で調節する。即ち、前記変位部材は、前記圧縮ばねの弾力と前記ソレノイドの吸引力とが釣り合う位置迄変位して停止する。

【0004】

【発明が解決しようとする課題】ところが、上述の様なソレノイドを利用した従来の電動式リニアアクチュエータの場合、変位部材を変位させる際に、ソレノイドに大きな電流を流す必要がある為、例えば自動車の油圧回路の切り換えに使用した場合、バッテリーに負担をかける原因となり、好ましくない。

【0005】又、圧縮ばねの弾力とソレノイドの吸引力とを釣り合わせる事で、前記変位部材の変位量を調節するが、圧縮ばねにより変位部材を付勢する構造はヒステリシスが大きい為、前記ソレノイドに同じ電流を流したとしても、前記変位部材を一方に変位させる場合と他方に変位させる場合とで変位量が大きく異なってしまう。この為、流量制御弁の開度を微調節する事等が難しかった。

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【0006】本発明の電動式リニアアクチュエータは、上述の様な不都合を解消するものである。

【0007】

【課題を解決するための手段】本発明の電動式リニアアクチュエータは、軸と、この軸と同心に、この軸に対する相対的回転を自在として設けられた筒と、この筒と前記軸との内で、回転のみ自在な一方の部材と固定の部分との間に設けられ、この一方の部材に回転方向の弾力を付与する弾性部材と、前記軸の外周面と前記筒の内周面との間に設けられ、前記一方の部材の回転に伴なって、前記軸と筒との内の他方の部材を、軸方向に亙って変位させる送り螺子部と、前記筒の周囲に設けられたケーシングと、このケーシングの内側に設けられて、通電に伴なって前記一方の部材を、前記弾性部材の弾力に抗して回転させる電動モータと、前記ケーシングと前記他方の部材との間に設けられ、この他方の部材の軸方向に亙る変位は許容するが回転を阻止する回り止め部とから構成される。

【0008】

【作用】上述の様に構成される本発明の電動式リニアアクチュエータの場合、電動モータへの非通電時には、軸と筒との内の一方の部材が、弾性部材の弾力により一方向に回転する。この際、前記軸と筒との内の他方の部材は、回り止め部により回転を阻止される為、送り螺子部によりこの他方の部材が、軸方向一端に迄変位させられる。

【0009】又、電動モータに通電すると、前記一方の部材が、通電量に応じて回転する。即ち、この一方の部材は、通電量に応じて定まる前記電動モータの回転トルクと、前記弾性部材の弾力とが釣り合う状態に迄回転した状態で停止する。そして、前記一方の部材の回転に伴ない、前記送り螺子部により前記他方の部材が、軸方向他端に向けて変位する。

【0010】

【実施例】図1～2は本発明の実施例を示している。中心部に設けられた軸1は、回転する事なく軸方向（図1の左右方向）にのみ変位し、流量制御弁の弁体等を駆動する（平行移動させる）。この軸1の周囲には、第一筒部2と第二筒部3とを互いに直列に組み合わせた筒4が、この軸1と同心に設けられており、更に、この筒4の周囲には、ケーシング5が設けられている。

【0011】後述する電機子6を介して接続され、前記筒4を構成する、前記第一筒部2と第二筒部3との内、第一筒部2は前記ケーシング5の前蓋7の内周縁に、第二筒部3は後蓋8の開口縁部に、それぞれ転がり軸受9、9を介して、回転のみ自在に支承している。

【0012】又、弾性部材である捩りコイルばね10の一端を、前記第二筒部3の端面に、この捩りコイルばね10の他端を前記後蓋8の内面に、それぞれ係止してい

る。この結果、前記第二筒部３を含む筒４には、回転方向の弾力が付与された状態となる。

【００１３】又、前記軸１の外周面に形成した螺旋溝１１と、前記筒４を構成する第二筒部３の内周面に形成した螺旋溝１２との間には、複数のボール１３、１３を設ける事で、ボール螺子機構を構成し、前記第二筒部３の回転に伴なって、前記軸１を軸方向に亙って変位させる送り螺子部１４を構成している。一方、前記後蓋８の内面中央部には、図２に示す様な非円形の凹部１５を形成しており、この凹部１５に、前記軸１の端部に形成した非円柱部１６を挿入している。そして、この非円柱部１６と前記凹部１５との係合により、前記軸１の軸方向に亙る変位は許容するが、この軸１の回転を阻止する回り止め部１７を構成している。

【００１４】更に、前記ケーシング５の内側には、通電に伴なって前記筒４を、前記捩りコイルばね１０の弾力に抗して回転させる電動モータ１８を設けている。即ち、前記ケーシング５の胴部を構成する円筒部１９の内周面に永久磁石２０を固定し、この永久磁石２０の内周面と、前記第一筒部２と第二筒部３とに掛け渡して設けられた電機子６の外周面とを対向させている。前記第一筒部２の外周面には整流子２１を固定しており、この整流子２１の外周面に、ブラシ２２の内端面を摺接させている。このブラシ２２は、前記円筒部１９に固設されたホルダ２３内に、この円筒部１９の直径方向に亙る変位を自在として嵌装され、圧縮ばね２４により、前記整流子２１に向け押圧されている。

【００１５】上述の様に構成される本発明の電動式リニアアクチュエータの場合、電動モータ１８への非通電時には、捩りコイルばね１０の弾力により筒４が、一方向に回転する。この際前記軸１は、回り止め部１７を構成する凹部１５の内周面と非円柱部１６の外周面との係合により、前記筒４と共に回転する事はない。この為、前記送り螺子部１４により前記軸１が、軸方向一端に迄変位させられる。

【００１６】又、前記ブラシ２２を介して電動モータ１８に通電すると、前記筒４が、通電量に応じて回転する。即ち、この筒４は、通電量に応じて定まる前記電動モータ１８の回転トルクと、前記捩りコイルばね１０の弾力とが釣り合う状態に迄回転し、通電量を変えない限り、そのままの状態で停止する。

【００１７】前記筒４を構成する第二筒部３の内周面と前記軸１の外周面との間には、ボール螺子機構である送り螺子部１４が設けられている為、前記筒４の回転に伴ない、前記送り螺子部１４により前記軸１が、軸方向他端に向けて変位する。従って、前記軸１の端部に流量制御弁の弁体等を支持すれば、前記電動モータ１８への通電量を変える事で、この流量制御弁による流量制御を行なえる。

【００１８】捩りコイルばね１０は、前記従来のソレノイド式のリニアアクチュエータに組み込まれている引っ張りばねに比べて、ばね自体のヒステリシスが小さく、しかも電動モータ１８の回転力を軸１の変位に変換する為の構造も、摩擦損失の小さなボール螺子機構により構成されている為、リニアアクチュエータ全体としてのヒステリシスは小さなものとなる。又、前記ボール螺子機構による送り螺子部１４が、電動モータ１８のトルクを増大させてから前記軸１に伝達する為、この軸１を軸方向に亙って変位させる為に、前記電動モータ１８に通電する電流の値が、比較的小さくて済む。

【００１９】尚、本発明の電動式リニアアクチュエータを構成する場合に、図示の場合とは逆に、軸１を回転させ、筒４を軸方向に変位させる構造とする事も出来る。

【００２０】

【発明の効果】本発明の電動式リニアアクチュエータは、以上に述べた通り構成され作用する為、少ない電力消費で大きな力を得る事が出来、しかもヒステリシスの小さな電動式リニアアクチュエータとして、流量制御弁等、各種機器を微妙に制御する事が可能となる。

【図面の簡単な説明】

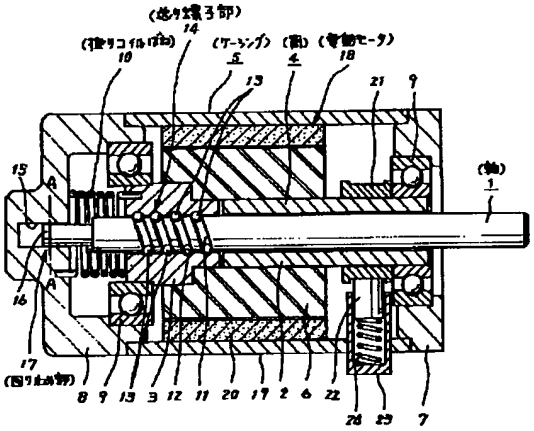
【図１】本発明の実施例を示す断面図。

【図２】図１の拡大Ａ－Ａ断面図。

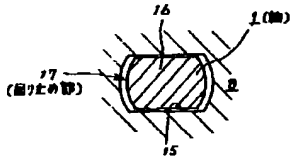
【符号の説明】

１　軸
２　第一筒部
３　第二筒部
４　筒
５　ケーシング
６　電機子
７　前蓋
８　後蓋
９　転がり軸受
１０　捩りコイルばね
１１　螺旋溝
１２　螺旋溝
１３　ボール
１４　送り螺子部
１５　凹部
１６　非円柱部
１７　回り止め部
１８　電動モータ
１９　円筒部
２０　永久磁石
２１　整流子
２２　ブラシ
２３　ホルダ
２４　圧縮ばね

【図1】


(絞り装置3部)
14
5
13
4
18
21
9
(軸)
1
15
16
17
8 9 13 3 12 11 20 17 2 6 22 23 7

【図2】


16
1(軸)
17
15